FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

PACIFIC SOUTHWEST
FOREST AND RANGE
EXPERIMENT STATION
BERKELEY - CALIFORNIA

MISCELLANEOUS PAPER

No. 52 August 1960

DISEASES THREATEN FOREST NURSERIES

Robert V. Bega, Plant Pathologist
Pacific Southwest Forest and Range Experiment Station
and
Richard S. Smith, Research Assistant
Department of Plant Pathology, University of California, Berkeley

Federal, state, and private foresters have begun a stepped up reforestation program in California. They have boosted the output of tree seedlings and are planning even greater production in forest nurseries. Are tree diseases a threat to these plans? Disease losses have been noticed in some California nurseries recently. Nurserymen took quick and aggressive action to check the losses, and special research was started at the Forest Service nursery at Placerville in 1959, soon after losses were noticed, to identify the troublesome fungi and to test various fungicides for their control. Results from control studies are not yet available, but the identification studies suggest that:

1. Damping-off and root rot fungi in nurseries may require more than usual attention.

2. Reforestation programs should guard against introducing new pathogens into forest areas.

THE DESTRUCTIVE AGENTS

Damping-off and root rot fungi are often inhabitants of forest nursery soils. These fungi vary widely in their ability to damage specific hosts and in their resistance to cultural and chemical control methods. As the first essential job of research, the fungi in the Placerville

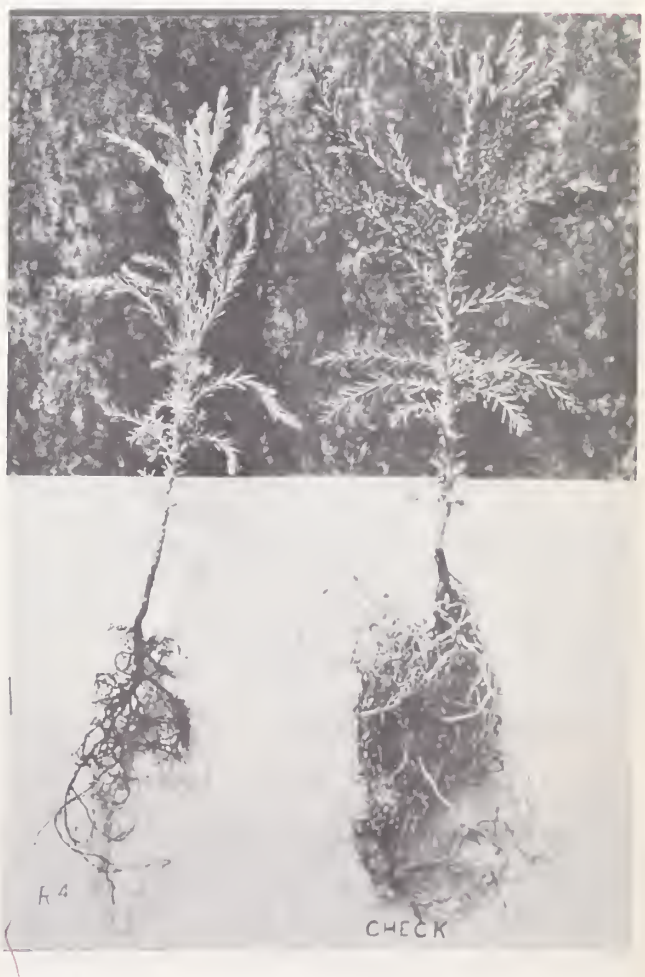

Figure 1.--Charcoal root rot of 2-year-old Sequoia gigantea, left, caused by Sclerotium bataticola.

nursery soils and in the diseased plants were identified by culturing them in the laboratory.

The charcoal root rot fungus, Macrophomina phaseoli (Sclerotium bataticola), proved to be the chief cause of high mortality in 1-year-old sugar pine, Douglas-fir, and giant sequoia. This fungus (fig. 1) is favored by high soil temperatures. It attacks several hundred genera of plants. Recent reports throughout the State indicate that it is assuming more importance as a root pathogen in forest nurseries and in agricultural crops.

Some of the identified diseases will require further study to evaluate their role as tree-killers. These include several forms of Fusarium oxysporum and F. solani isolated from the diseased plants and the nursery soil. Inoculation of healthy plants with these isolates may show them to be a cause of mortality. But fungi of this genus are highly host-specific, and clones of these species are common saprophytes found as secondary invaders in the infected roots of many diseased plants. Hence their isolation from diseased tissue is not an indication of pathogenicity. Rhizoctonia solani, Phoma sp., and Pythium were also isolated from the diseased roots, but with low enough frequency that their present role in the disease complex is important primarily in cases of damping-off.

Two other fungi present a definite hazard. Phytophthora cinnamomi and Armillaria mellea were the cause of limited spot killing in one area of the nursery on 2-year-old sugar pine. Both are extremely dangerous root-rotting fungi with a wide range of host plants.

CONTROL MEASURES IN THE NURSERY

The phytophthora root rot was considered to be so great a threat that a three-pronged eradication program was put into effect. First all the 2-year-old sugar pine in and around the diseased areas were condemned and destroyed. Then chemical eradication of the pathogen in the infested soil was attempted on the half-acre containing the infection centers. Just before planting, a soil fumigant of 57 percent methyl bromide and 43 percent chloropicrin (Pathofume) was applied by shank injection at a rate equivalent to 450 pounds per acre (fig. 2). The area was then sealed under polyethylene for 24 hours. This high dosage of fumigant was used to insure eradication of the pathogen. Finally, all sugar pine planting stock from the uninfected nursery areas are being followed in the field. Those that die will be checked to see if phytophthora root rot is the cause of death. If it is, immediate spot fumigation will be carried out in the field.

Figure 2. --Shank injection of soil fumigants.

Because of the difficulty in controlling sclerotia-forming soil fungi, a wide range of soil fungicides is now being tested at Placerville. Eight fungicides in 11 treatments have been applied on small test plots in one area of the nursery where damage was prevalent in 1959 (fig. 3). The individual treatments were applied to 50-square-foot plots, each of which is surrounded by a buffer strip which was fumigated with a high dosage (435 pounds per acre) of chloropicrin. The buffer strips were used to lessen the chance of contamination from the surrounding non-treated soil. The treated areas have been seeded with sugar pine, and the results from these tests will be evaluated as to efficacy of control and economy of application.

Figure 3. --Experimental plots at Placerville nursery.

RESULTING PROBLEMS IN THE FIELD

The nurserymen can measure disease losses, but only by the mortality and the obvious decline of planting stock still in the nursery beds. Initial stages of infection in seedlings are not easily detected except by close laboratory examination. But loss in the nursery is only one facet of the overall problem issuing from nursery diseases.

Plants with a seriously impaired root system may not show symptoms of disease while they are growing under the ideal environmental conditions of the nursery. However, when these seedlings are planted out in the field under less favorable environmental conditions, the diseased root system is unable to function efficiently and the seedling dies.

Losses of seedlings in the nursery are serious enough; the introduction of a new and virulent pathogen into the forested areas of California would be disastrous. One of the most effective means of introducing these destructive agents into a new area is by planting diseased nursery stock.

Phytophthora cinnamomi is a very destructive, introduced organism with a reported host range of some 100 plants, many of which are forest trees. This organism is a causal agent of the little leaf disease in the southern pines and has been found to be the cause of mortality of Pinus radiata and Cupressus macrocarpa in New Zealand. So far, it has not been found in forest areas of California.

Armillaria mellea, another of the fungi isolated from the nursery stock, is pathogenic on many western coniferous forest trees. Douglas-fir is so susceptible to this pathogen that it has been used as a test plant in determining the presence of the organism in questionable soils.

The problem becomes even more serious when we realize that once these pathogens are introduced, there are no known methods of controlling them economically in a forested area.